CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

E5 - ADVANCED PHOTOGRAMMETRY

March 2013

Although programmable calculators may be used, candidates must show all formulae used, the substitution of values into them, and any intermediate values to 2 more significant figures than warranted by the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct.

Note: This examination consists of 11 questions on two pages.

Time: 3 hours

Q. No		Marks Value	Earned
1.	a) What is the role of the Interior Orientation (IO) in the photogrammetric reconstruction procedure? b) What is the role of the geo-referencing in the photogrammetric reconstruction procedure? c) Which one of the following points (i.e., the center of the given windows) can be considered as an interest point? Why? 95 94 84 23 94 84 86 25 96 or 34 26 96 100 97 87 36 22 25	2 2 3	
2.	a) What is meant by Quality Assurance (QA) and Quality Control (QC)? b) What are the factors that should be considered in the QA for a photogrammetric mapping mission? c) What are the QC measures for evaluating the outcome from a photogrammetric mapping mission?	2 4 2	
3.	a) For a photogrammetric system, the horizontal accuracy is superior to the vertical accuracy. Do you agree with this statement? Why? b) For a LiDAR system, the vertical accuracy is superior to the horizontal accuracy. Do you agree with this statement? Why? c) What are the systematic errors that might be present in a LiDAR system? How can you mitigate the impact of these errors? d) What are the factors that would affect the inter-point spacing for LiDAR data?	2 2 3 3	
4.	a) What is the conceptual basis for evaluating the relative accuracy of LiDAR data? What would be the main challenge in this procedure? How would you mitigate such a challenge? b) What is the conceptual basis for evaluating the absolute accuracy of LiDAR data? What would be the main challenge in this procedure? How would you mitigate such a challenge?	5 4	
5.	a) Can you carry out a photogrammetric reconstruction of a GPS-aided photogrammetric triangulation of a single flight line without any ground control points? Why? b) What is meant by the following specifications and their typical values for commercial airborne LiDAR systems: i. Scan rate/frequency, ii. Pulse rate/frequency, iii. Ground spacing, and iv. Beam divergence?	2 4	

6.	a) What is the underlying assumption for using a projective transformation to relate the image and object space coordinates? b) Briefly explain the conceptual basis for using the Rational Functional Model to relate the image and object space coordinates. c) What are the main differences between the collinearity equation and Direct Linear Transformation models? d) What is meant by LiDAR data segmentation? What are the different alternatives for the segmentation of LiDAR data together with the pros and cons of these approaches?	2 2 2 5	
7.	a) What are the main components of an airborne LiDAR mapping system? b) What are the main factors affecting the size of the laser footprint? c) What is the conceptual basis of point positioning using a LiDAR system? d) What are the main advantages of LiDAR when compared to a photogrammetric system? e) What are the main advantages of a photogrammetric system when compared to LiDAR? f) How would you compare the intensity image generated from a LiDAR system to an optical image?	2 3 2 2 2 2	
8.	a) What is the main limitation of a digital frame camera when compared with an analogue one? b) What are the different alternatives for stereo-coverage using line cameras? c) How would the stereo-coverage alternatives associated with line cameras affect the Ground Sampling Distance (GSD) in the acquired scenes?	2 3 3	
9.	a) What are the differences between direct and indirect transformation during image rectification? Tabulate the advantages and disadvantages of each method. b) What is meant by the double mapping problem when generating orthophotos from large scale imagery over urban areas? c) Explain the conceptual basis of the z-buffer method for true orthophoto generation	4 3 3	
10.	a) What is the objective of image matching? b) What is the conceptual basis of the cross-correlation-based image matching? c) What is meant by image resampling according to epipolar geometry? How would this process facilitate the image matching procedure?	2 3 3	
11.	a) What would be the contribution magnitude (i.e., significant versus insignificant) of an INS in the following situations (explain why): i. GPS/INS-controlled photogrammetric triangulation of an image block captured by wide-angle frame camera? ii. GPS/INS-controlled photogrammetric triangulation of an image block captured by a narrow-angle line camera? b) What is the impact of biases in the Interior Orientation Parameters (IOP) on the reconstruction outcome from photogrammetric triangulation aided by GPS/INS observations or GCP? Why? c) What would you expect from a GPS/INS-controlled triangulation and intersection procedures in terms of the quality of the reconstructed object space? Why?	4 3 3	
	Total Marks:	100	